

## NASA's Software Bank

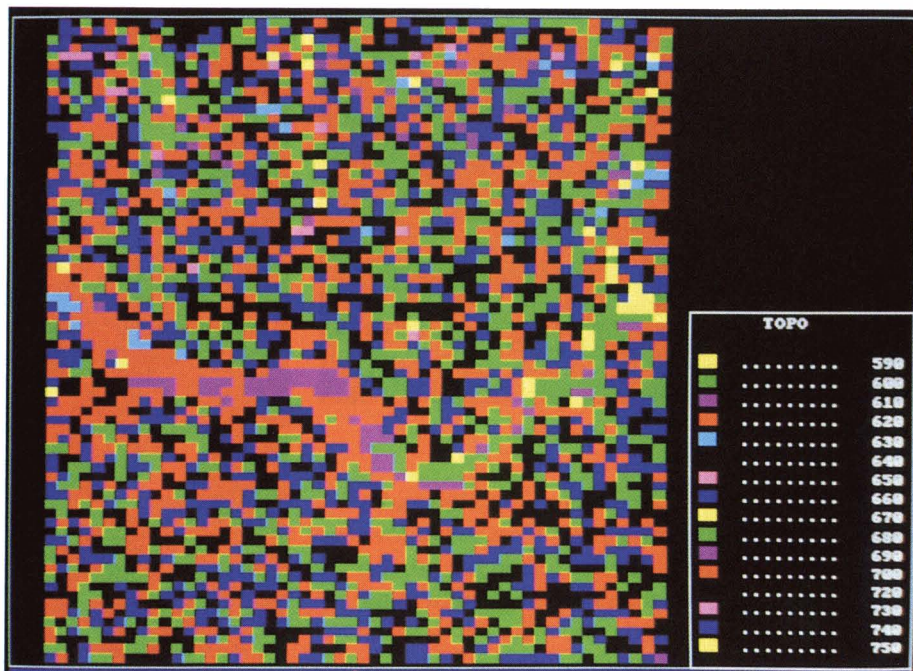
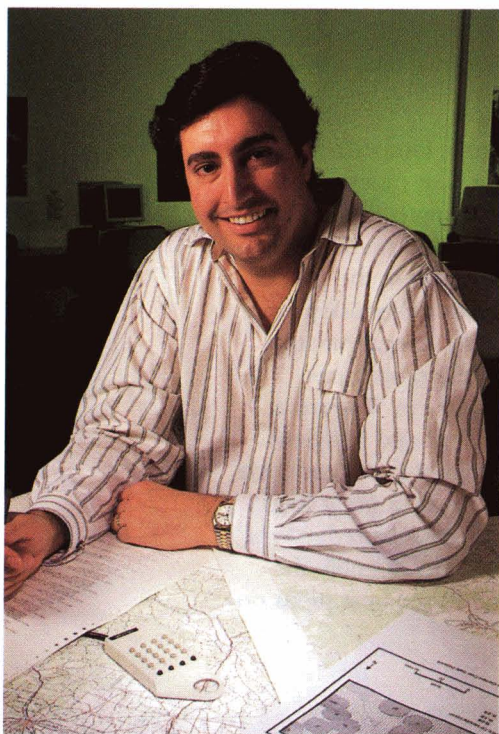
*A special NASA service aids national productivity by providing low cost computer programs to public and private sector clients*

In an era of heightened environmental awareness, finding sites to dispose of solid waste is a difficult, complicated and tedious process, often a tug-of-war between state and local community officials.

Each candidate landfill site must meet a series of rigorous criteria, for example, slope, distance to cultural features, surface and subsurface hydrology, soil erosion potential and land

ownership; in addition, the site must be sufficiently distant from residential areas, schools, airports, population centers and endangered species habitats.

Researchers at Ohio University, Athens, Ohio, are trying to make site selection less complex by programming computer software to help evaluate a candidate site. Their tool is a NASA-developed program called CLIPS, a software shell for developing expert systems. Originally developed by Johnson Space Center, CLIPS is designed to allow



At Ohio University, assistant geography professor James Lein (left) has adapted a NASA computer program to a novel use: simplifying the evaluation and selection of landfill sites for solid waste disposal. An expert system developed with the CLIPS program uses details about a candidate site, such as topography (above) or adjacent water sources (upper right) to determine whether the site meets requirements.

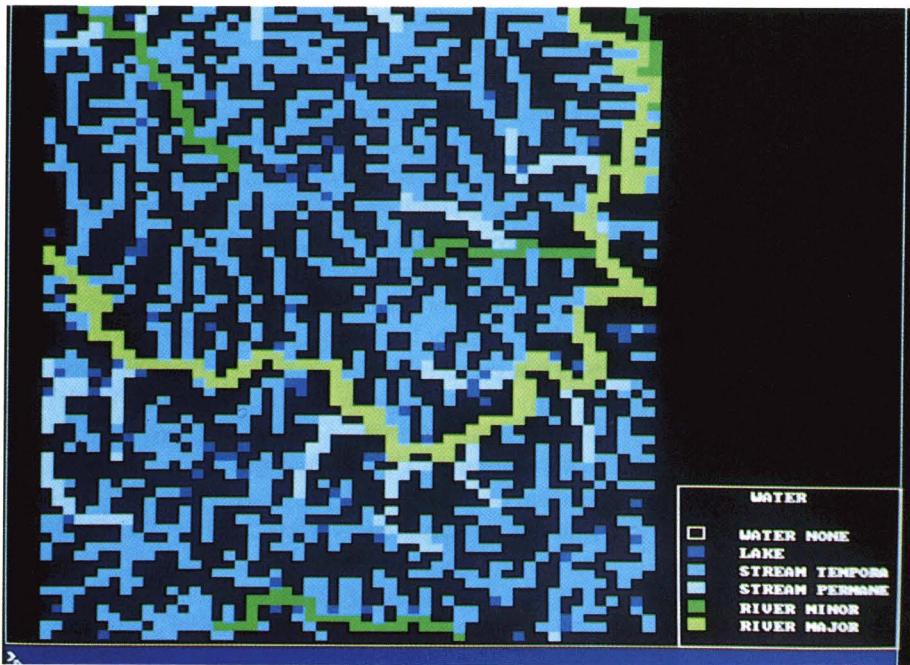
research and development of artificial intelligence on conventional computers.

Says Dr. James Lein, assistant professor of Ohio University's Geography Department:

"We structure the rules and parameters surrounding the decision-making process and CLIPS provides an estimate of whether a particular site fulfills the siting requirements." With an expert system, the reasoning mechanisms influencing site selection can be defined more clearly and the system can be modified to reflect changes in legislation or new information. With an expert system the site selection process is less difficult, reducing the time and costs involved. CLIPS was supplied to Ohio University by the Computer Software Management and Information Center (COSMIC)<sup>®</sup>, NASA's mechanism for helping industrial, government and institutional organizations to effect significant reduction of automation costs.

Information processing by computer is still experiencing explosive growth in the United States.





Thousands of organizations are joining the ranks of computer users annually, while longtime users are regularly finding new ways to improve their operations through greater automation. NASA's way of helping them cut costs is providing them, at low cost, previously developed computer programs that have secondary utility.

Development of an entirely new program is time consuming and expensive. Frequently, however, a program developed for one purpose can be adapted to an entirely different application. Thus, software users can save time and money by taking advantage of COSMIC's service; they can purchase a program for a fraction of its original cost and get a return many times the investment, even when the cost of adapting the program to a new use is considered.

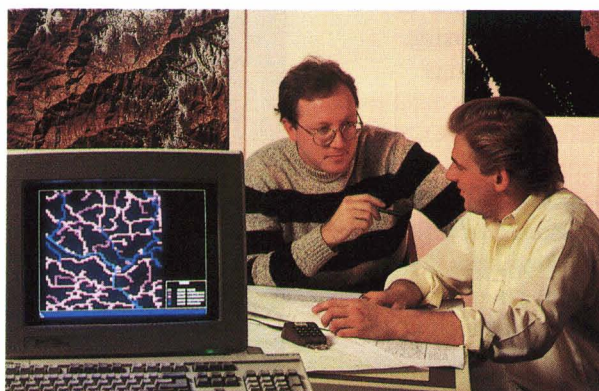
The CLIPS program has proved a valuable research tool for a wide variety of applications. At Ohio University, researchers are also exploring use of CLIPS to assist in historic preservation, which involves identification, inventory and selection of structures — or entire areas — that have special cultural or historic significance.

Other examples of CLIPS' versatility include its use to monitor product quality and quantity at a chemical plant; its employment by an attorney to help him decide which facts from a casefile are most pertinent; and its use as the core of an advanced software system that gives a user engineer instant

expertise in disciplines in which he is not skilled. Another use of CLIPS is its inclusion in a text book — *Expert Systems: Principles and Programming*, by Joe Giarratano and Gary D. Riley — in use at 40 colleges and universities. CLIPS serves as the prime example of an expert system development tool in the book; sample CLIPS applications are included on a disc bound with the text book, enabling students to design and develop their own expert systems.

Widely used in business and government, CLIPS represents only one of thousands of examples wherein users have benefited from COSMIC's service.

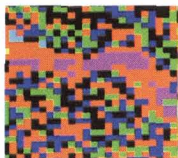
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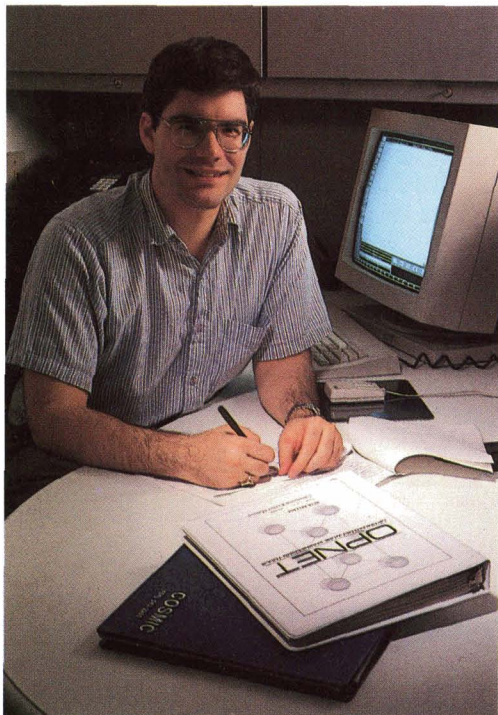
Ohio University graduate students use the CLIPS program to develop an expert system for historic preservation, which involves evaluation of structures or areas that have special cultural or historic significance.

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## NASA's Software Bank (Continued)



Steve Baraniuk of MIL 3, Inc. uses a COSMIC computer program in his company's OPNET software package, which develops computer simulations of satellite communications networks.

programs and informs potential customers of their availability through a catalog and through notices in the publication *NASA Tech Briefs*.

COSMIC's library contains more than 1,200 programs for such purposes as structural analysis, artificial intelligence, computational fluid dynamics, thermal analysis, image processing, project management and a great variety of other functions. The center has distributed thousands of programs, some of which have made possible savings amounting to millions of dollars. Thus, COSMIC's service represents one of the broadest areas of economic benefit resulting from secondary use of government developed technology.

An OPNET image showing a satellite track against a world map background.

Located at the University of Georgia, Athens, Georgia, NASA's Computer Software Management and Information Center (COSMIC) is custodian of the large "bank" of computer programs developed in the course of work sponsored by NASA, the Department of Defense and other technology generating agencies of the government.

COSMIC gets a continual flow of these government-developed software packages and identifies those that can be adapted to secondary usage. The center stores and maintains the

Among examples of COSMIC program uses by industry are:

MIL 3, Washington, D.C., a developer of software for the communications industry, supplies a software package — called OPNET — for developing simulations of communications satellite networks. OPNET easily supports geosynchronous or "stationary" satellites. However, the movement of low Earth orbit satellites was not supported and the frequent loss of communications when Earth blocks the line-of-sight between satellite and Earth station was not predictable.

In order to support predictions of low Earth orbit as an interim measure, pending a planned advancement of OPNET that will allow predicting satellite occlusion, MIL 3 is using a COSMIC program called ASAP (Artificial Satellite Analysis Program) as an OPNET enhancement. MIL 3 translated the ASAP program from the original FORTRAN to C language and integrated the modified version of ASAP into OPNET. The ability to directly utilize ASAP code has enabled MIL 3 to offer low Earth orbit satellite modeling capability much sooner. A planned OPNET advancement involves development of a customized second-generation orbital mechanics program based on ASAP.

Heath Tecna Aerospace Company, Kent, Washington, a major supplier of composite structures, designed and built the first full scale composite hybrid rocket motorcase. Looking for a computer program that would predict stresses in the

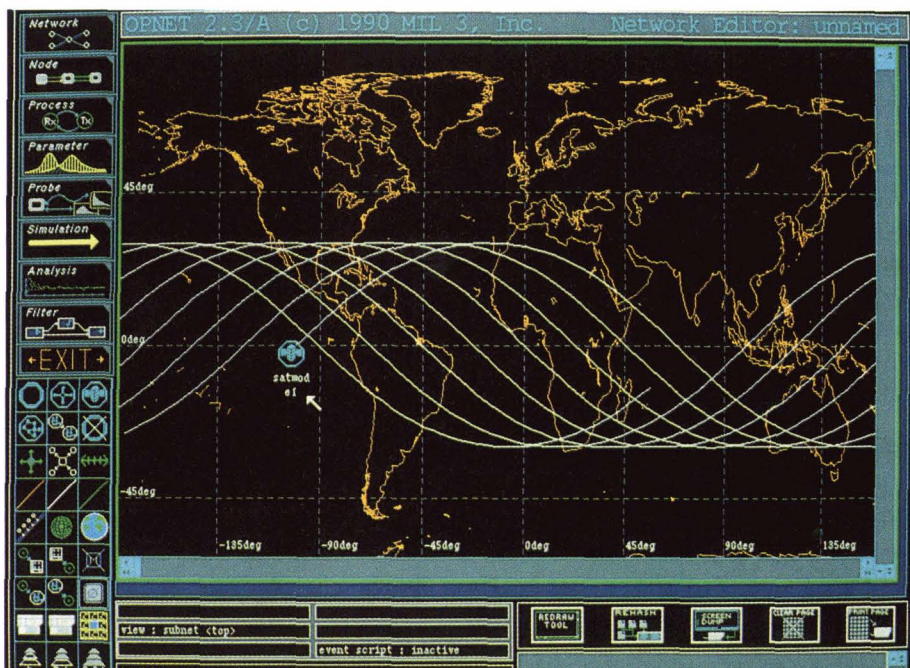






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The first test firing of an AMROC rocket motor employing a new composite motorcase developed by Heath Tecna Aerospace with the help of COSMIC software.

motorcase walls and calculate the ideal geometry for the domes at either end of the filament-wound pressure vessel, company researchers discovered and used a COSMIC program descriptively titled "Analysis of Filament Reinforced Metal Shell Pressure Vessels."

The test motor was built under contract to American Rocket Company (AMROC), builder of privately-developed rocket launch vehicles. Heath Tecna confirmed the predictions of the COSMIC program by testing a subscale motorcase to failure. A full-scale 22-foot motorcase was then fabricated and successfully test fired by AMROC.

Scientific-Atlanta Inc., Atlanta, Georgia, is an internationally known leader in cable television electronics and satellite communications networks. Company engineers were assigned the task of designing a new Cassegrain antenna, which consists of a primary radiator, a multimode horn to receive signals, a main reflector and a subreflector.

Researchers found — and purchased — the COSMIC program "Machine Design of Cassegrain Feed System," which seemed uniquely formulated to design this special type of antenna. The program allowed for computer simulations of the antenna's performance, allowing engineers to change the

provided for greater operational economy.

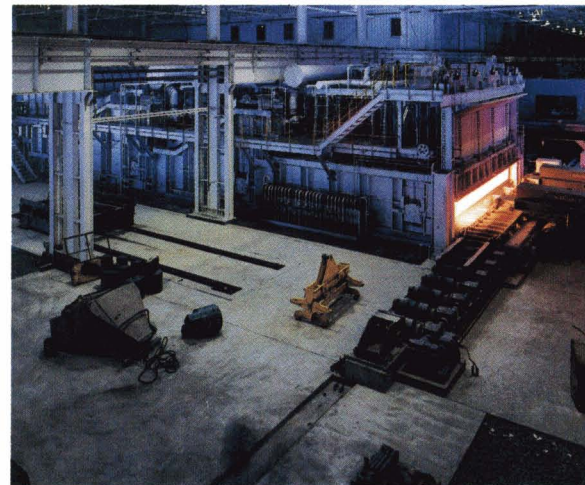
Salem Automation, Pittsburgh, Pennsylvania, conducted research on methods whereby increases in energy efficiency and quality might be achieved in reheat furnaces. The reheat furnace is an energy intensive stage of steel processing, used to raise the

design before any hardware was actually built. The program saved time and money in the design process, and additionally enabled engineers to build a vertex tuning plate intended to redirect scattered energy, which



A COSMIC program contributed time and monetary savings in the design of a new type Cassegrain antenna developed by Scientific-Atlanta Inc.

to evaluate technology intended to increase productivity and reduce energy usage in the reheat process. The COSMIC program — the General Thermal Analyzer Program — solves steady state and transient thermal problems using desk top computers. Salem Automation used it in modeling reheat furnaces; for example, the program can simulate how slabs in a proposed furnace will heat during operation.



temperature of steel slabs, blooms or billets to the point where they can be formed by rolling.

Along with other software, the company used a COSMIC program

A reheat furnace used in steel processing. Salem Automation used a COSMIC computer program in a research project intended to increase productivity and reduce energy usage in the reheat process.